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Article (Published Version)

Harris, Philine S, Harris, Peter R and Miles, Eleanor (2017) Self-affirmation improves performance on tasks related to executive functioning. *Journal of Experimental Social Psychology*, 70. pp. 281-285. ISSN 0022-1031

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Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

Self-affirmation improves performance on tasks related to executive functioning

Philine S. Harris *, Peter R. Harris, Eleanor Miles

School of Psychology, University of Sussex, Falmer BN1 9QH, United Kingdom

HIGHLIGHTS

- We assessed performance on executive functioning tasks following self-affirmation.
- The tasks measured core executive functioning aspects: working memory and inhibition.
- Self-affirmation improved performance on both tasks.
- This may help explain the wide range of beneficial effects of self-affirmation

ARTICLE INFO

Article history:

Received 9 May 2016

Revised 18 November 2016

Accepted 25 November 2016

Available online xxxx

Keywords:

Self-affirmation
Executive functioning
Working memory
Inhibition

ABSTRACT

Objectives: The current study explored the effect of self-affirmation on two aspects of performance that have been related to executive functioning: working memory (assessed by a 2-back task) and inhibition (assessed by a Stroop task). The goal was to establish whether self-affirmation improved performance on these tasks.

Method: Participants ($N = 83$) were randomized to either a self-affirmation or a control task and then completed the computerized tasks, in a fixed sequence.

Results: Self-affirmed participants performed better than non-affirmed participants on both tasks.

Conclusion: Self-affirmation can improve aspects of performance related to executive functioning. This finding may help to explain the wide range of beneficial effects that self-affirmation can have on cognition and behavior.

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Self-affirmation (e.g., reflecting upon a personally important value) has elicited a broad range of positive effects in many studies in social and health psychology (for reviews, see [Cohen & Sherman, 2014](#); [Sherman & Cohen, 2006](#)). These include beneficial effects on academic achievement (e.g., [Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009](#)), self-control ([Schmeichel & Vohs, 2009](#)), task performance ([Creswell, Dutcher, Klein, Harris, & Levine, 2013](#)), and health-related behavior (e.g. [Epton, Harris, Kane, van Koningsbruggen, & Sheeran, 2014](#)).

How does self-affirmation have such diverse effects? One possibility is that it influences an underlying ability that has broad consequences. One candidate for such a general ability with broad performance implications is executive functioning. To explore this possibility, the current study tested the effects of self-affirmation on performance on two tasks that are related to executive functioning: working memory and inhibition.

1. Self-affirmation and executive functioning

According to self-affirmation theory ([Steele, 1988](#)), people are strongly motivated to uphold their self-integrity – their sense of being “adaptively and morally adequate” ([Steele, 1988, p. 262](#)). Self-integrity can be maintained by affirming the self, whereby individuals remind themselves of their important self-aspects through action or thought. Executive functioning refers to “those mental capacities necessary for formulating goals, planning how to achieve them, and carrying out the plans effectively” ([Lezak, 1982, p. 281](#)). It is considered essential for reasoning, maintaining focus and attention, and generating and completing goals and plans ([Miyake et al., 2000](#)).

Experimental manipulations of self-affirmation have been shown to affect outcomes that involve executive functioning. For example, self-affirmed individuals form stronger intentions to act in healthier ways than non-affirmed individuals after reading health-risk information and may subsequently act more healthily ([Epton et al., 2014](#); [Sweeney & Moyer, 2015](#)). Executive functioning is thought to be crucial both to forming ([Allan, Johnston, & Campbell, 2011](#)) and executing ([Hofmann, Schmeichel, & Baddeley, 2012](#)) the intention to act more healthily. Self-affirmation has been associated with academic achievement at

* Corresponding author.

E-mail addresses: philine@sussex.ac.uk (P.S. Harris), p.r.harris@sussex.ac.uk (P.R. Harris), e.miles@sussex.ac.uk (E. Miles).

school (Cohen et al., 2009) and college (Miyake et al., 2010), and with better problem-solving (Creswell et al., 2013). Executive functioning is believed to play an important role in both academic achievement (St Clair-Thompson & Gathercole, 2006) and general problem-solving (Suchy, 2009).

Executive functioning consists of many different processes. However, two broad processes have been identified as being key (Jurado & Rosselli, 2007): working memory and inhibition, which interact dynamically (Roberts & Pennington, 1996). Working memory is heavily implemented in making short- and long-term plans, and successful goal achievement (Suchy, 2009). Inhibition allows the suppression of responses that may interfere with a goal (Kane & Engle, 2003). To date, however, there is only limited evidence that self-affirmation affects either. Logel and Cohen (2012) found self-affirmation improved working memory performance some 2.5 months (on average) after the self-affirmation task. Legault, Al-Khindi, and Inzlicht (2012) found self-affirmation improved performance on an inhibition task (the Go/No-Go task, in which participants inhibit responses to a stimulus). These findings are promising, but have some interpretative issues that undermine the evidence that self-affirmation can improve performance on such tasks. For instance, given the time lag between manipulation and measure, it is unclear whether the improvement in working memory observed by Logel and Cohen (2012) was an immediate or delayed effect of self-affirmation, perhaps induced by changes in behavior or cognitions that also affect executive functioning, such as physical activity (Kramer & Erickson, 2007) or self-efficacy perceptions (Bouffard-Bouchard, 1990). Likewise, the Go/No-Go task is considered primarily a measure of motor response inhibition (Nigg, 2000) and it would be useful to test the effects on a task that also assesses other aspects of inhibitory control that are key to successful self-regulation, such as the ability to focus on a goal despite distractions (Rueda, Posner, & Rothbart, 2005). One such task is the Stroop task (Stroop, 1935), which is considered a measure of response inhibition, attentional vigilance, response selection (Suchy, 2009) and goal maintenance (Kane & Engle, 2003).

The current study therefore assessed the immediate impact of self-affirmation on performance on a working memory (2-back) and inhibition (Stroop) task and sought to provide laboratory-based evidence of the effects of self-affirmation on these key aspects of executive functioning. The study tested the hypothesis that self-affirmed participants would perform better than non-affirmed participants on both tasks.

2. Method

2.1. Participants

The sample consisted of 83 psychology undergraduates at the University of XXX who participated for course credits. A priori power analyses indicated that the minimum required sample size to detect an effect of the size ($d = 0.7$) found in Logel and Cohen (2012) with 80% power would be 67 participants. To allow for potential losses through mistakes and misunderstandings, we continued data collection until the course credit deadline. Participants were between 18 and 35 years old ($M = 20.27$, $SD = 3.00$). Most were female (78.30%), white (71.10%) and British (78.30%).

2.2. Procedure and design

Participants completed an online questionnaire, followed by a face-to-face session held at least two days later. They were randomly allocated to the self-affirmation or control task (the experimenter remained blind to condition), both of which were presented as writing tasks. Participants, who were tested individually, spent 10 min writing and then completed the working memory task, followed by the inhibition task (described below). The study was presented as being on 'the link between personality and cognitive skills'. A funnel debrief (Chartrand & Bargh, 1996) confirmed no participant suspected otherwise.

Participants were not put under any explicit pressure to perform well on the tasks.

2.3. Materials and measures

2.3.1. Baseline measures

Participants answered questions relating to their demographic information (such as age, sex, nationality) in an online questionnaire.¹

2.3.2. Self-affirmation manipulation

Participants in the self-affirmation condition wrote about their most important value (why it is important to them and how it influences their behaviors or attitudes; Sherman, Nelson, & Steele, 2000). In the control condition participants wrote about their least important value (why it might be important to someone else and how it might influence other people's behaviors or attitudes).

2.3.3. Working memory

Working memory was measured with the 2-back task, using the same instructions as Logel and Cohen (2012). Participants were presented with a sequence of 45 letters, each of which stayed on screen for 500 ms, followed by a blank screen for 2.5 s. For each letter, participants had to indicate whether or not the current letter matched the letter that had appeared two positions previously. The dependent measures were the proportion of correct trials, mean reaction time (RT), and inverse efficiency, which was calculated by dividing RT by the proportion of correct responses (Townsend & Ashby, 1983). It represents the time participants took per correct answer, and thus takes the trade-off between speed and accuracy into account. A lower score indicates quicker correct responding and therefore greater efficiency.

2.3.4. Inhibition

The Stroop task required participants to indicate the color of a string of letters. These were either a string of X's or color words, resulting in three trial types: Neutral (XXXX in red or blue), congruent (red in red or blue in blue) and incongruent (red in blue or blue in red). The task consisted of 60 trials (20 of each type, all in random order). The procedure was a replication of Jostmann and Koole (2007), with the exception that the interval blank screen was reduced from 2s to 1s to reduce inter-stimulus waiting time.

The dependent measures were the proportion of correct trials, mean RT, inverse efficiency and interference, calculated by subtracting mean accuracy and mean RT for neutral trials from the equivalent means for incongruent trials (Macleod, 1991).

3. Results

3.1. Preliminary analysis

Chi square analyses revealed no significant associations between condition and sex, ethnicity or nationality (all $ps > 0.42$). One-way ANOVA comparing age between self-affirmation ($M_{SA} = 19.71$ years, $SD = 2.75$) and control conditions ($M_{NA} = 20.83$ years, $SD = 3.17$)

¹ All measures, manipulations, and exclusions in this study have been reported with the exception of several individual difference measures that are part of the broader program of research of which this study forms part, but that do not relate to the specific issues reported in this paper. These were measures of self-control (Tangney, Baumeister, & Boone, 2004), self-esteem (Rosenberg, 1965), positive affect (Usala & Hertzog, 1989), self-integrity (Sherman et al., 2009), spontaneous self-affirmation (Harris et al., n.d.), general self-efficacy (Schwarzer & Jerusalem, 1995), self-compassion (Neff, 2003), optimism (Scheier, Carver, & Bridges, 1994), heuristic/systematic processing (Griffin, Neuwirth, Giese, & Dunwoody, 1999) and empathic concern (Davis, 1983). Affect was also measured immediately following the manipulation, but no main effect of self-affirmation on affect was found. (The affect findings will be reported in a separate paper, Harris, Harris & Miles, in prep.)

approached significance $F(1, 81) = 2.93, p = 0.09$, Cohen's $d = 0.38$. Controlling for age in the analysis did not alter the pattern of results.

Before analysis, the RT data were scanned for responses faster than 150 ms or slower than 10,000 ms to identify implausible responses or participants who may have disengaged from the task (<1% of responses) (cf. Greenwald, Nosek, & Banaji, 2003). Next, any outliers (RTs ± 2 SDs of each participant's mean) were removed (4% of responses). RT data were heavily skewed and therefore normalized using square root transformation. However, the pattern of results and the conclusions did not differ following transformation; therefore analyses reported here use the non-normalized data.

3.2. Impact of manipulation on dependent measures

3.2.1. Working memory task

The data of 7 participants who had misunderstood the instructions (4 from the self-affirmation condition) were excluded from the analysis, leaving a sample of 76 (59 female). One-way ANOVAs revealed significant differences in accuracy, $F(1, 74) = 5.75, p = 0.02, d = 0.55$, and inverse efficiency, $F(1, 74) = 5.61, p = 0.02, d = 0.54$, but not RT, $F(1, 74) = 2.41, p = 0.13, d = 0.36$, between conditions. Self-affirmed participants performed better on the working memory task and were more efficient (see Table 1).

3.2.2. Inhibition task

One-way ANOVAs revealed significant differences in overall RT, $F(1, 81) = 4.20, p = 0.04, d = 0.42$: self-affirmed participants reacted faster to all trials than non-affirmed participants (see Table 2). There were no significant differences in overall accuracy, $F(1, 81) = 0.13, p = 0.72, d = 0.01$. There were marginally significant differences in overall Inverse Efficiency, $F(1, 81) = 3.56, p = 0.06, d = 0.42$: self-affirmed participants responded more quickly than non-affirmed without a cost to accuracy. Moreover, self-affirmed participants showed marginally less interference than non-affirmed participants, $F(1, 81) = 3.32, p = 0.07, d = 0.40$.

4. Discussion

This study explored the immediate impact of self-affirmation on two aspects of executive functioning: working memory and inhibition. As hypothesized, self-affirmation resulted in superior performance on both tasks. Compared to their non-affirmed counterparts, self-affirmed participants made fewer errors on the working memory task and responded faster on the Stroop task. Inverse efficiency analyses demonstrated that these performance improvements were not the result of speed-accuracy tradeoffs. Rather, self-affirmed participants responded more efficiently on both tasks.

The working memory finding replicates those of Logel and Cohen (2012) – indeed, the effect sizes in both studies are similar (Cohen's $d = 0.6$ vs 0.7 in Logel and Cohen) – and extends them by establishing that the beneficial effects of self-affirmation are evident immediately after the self-affirmation manipulation. The Stroop findings extend those of Legault et al. (2012) by demonstrating that self-affirmation can boost performance on a more complex inhibition task. These performance benefits involved a general speeding-up of response times, rather than a reduction in interference on high-conflict trials.

Table 1

RT and accuracy for the working memory task. Standard deviations given in parentheses.

	Control (<i>n</i> = 38)	Self-affirmation (<i>n</i> = 38)	<i>F</i> ^b	<i>p</i>
RT (ms)	836.45 (276.07)	750.05 (203.64)	2.41	0.13
Accuracy	0.80 (0.12)	0.86 (0.07)	5.75	0.02
Inverse efficiency ^a	1062.81 (379.58)	884.60 (266.92)	5.61	0.02

^a RT divided by accuracy.

^b Univariate *F*s testing means across conditions, *df* = 1, 74.

Table 2

RT and accuracy for the inhibition task. Standard deviations given in parentheses.

	Control (<i>n</i> = 41)	Self-affirmation (<i>n</i> = 42)	<i>F</i> ^c	<i>p</i>
RT (ms)				
Overall	515.47 (133.30)	455.15 (134.91)	4.20	0.04
Neutral trials	496.85 (108.71)	445.10 (114.08)	4.47	0.04
Congruent trials	499.11 (135.30)	433.32 (119.26)	5.53	0.02
Incongruent trials	550.45 (171.76)	487.03 (180.76)	2.68	0.11
Interference ^a	53.60 (94.80)	41.93 (86.19)	0.35	0.56
Accuracy				
Overall	0.95 (0.05)	0.95 (0.04)	0.13	0.72
Neutral trials	0.96 (0.06)	0.94 (0.07)	2.31	0.13
Congruent trials	0.97 (0.06)	0.97 (0.05)	0.03	0.87
Incongruent trials	0.92 (0.09)	0.94 (0.06)	0.47	0.50
Interference ^a	0.04 (0.08)	<0.01 (0.08)	3.32	0.07
Inverse efficiency ^b				
Overall	544.11 (138.65)	483.84 (151.77)	3.56	0.06
Neutral trials	516.82 (107.31)	473.27 (110.96)	3.30	0.07
Congruent trials	514.97 (134.68)	449.45 (128.71)	5.14	0.03
Incongruent trials	600.55 (195.22)	528.81 (233.35)	2.30	0.13

^a Incongruent relative to neutral.

^b RT divided by accuracy.

^c Univariate *F*s testing means across conditions, *df* = 1, 81.

The improvements in efficiency evident in the working memory task were larger in magnitude than the improvements observed in the subsequent Stroop task, perhaps because the impact of the self-affirmation manipulation wanes with time or the first task induces depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998; although see Hagger et al., 2016). Nonetheless, the overall pattern of results suggests that the effects of self-affirmation are not specific to one particular ability, such as working memory or inhibition; rather, self-affirmed participants demonstrated a general increase in response speed and performance. Furthermore, these effects occurred in a context in which participants were not put under explicit pressure to perform well; that is, no attempt was made to heighten the self-evaluative concerns that participation in a face-to-face laboratory study with a performance element may entail. The findings therefore contribute to a small but growing body of evidence of self-affirmation effects in the context of naturally experienced levels of threat or conflict, rather than ones explicitly induced or heightened artificially by the experimenters (c/f. Armitage, 2016; Logel & Cohen, 2012; Nelson, Fuller, Choi, & Lyubomirsky, 2014).

We examined executive functioning because it is heavily involved in self-regulatory behaviors relating to outcomes such as health or academic achievement that self-affirmation has been shown to benefit (e.g. Cohen et al., 2009; Epton et al., 2014). Theoretically, the question is why self-affirmation might boost performance on such tasks. This is an open question, but we hypothesize that self-affirmation boosts task engagement and, consequently, readiness to deploy one's available resources to perform well, rather than directly boosting the underlying ability itself. That is, the effects are primarily motivational. This explanation requires explicit testing but is consistent with recent theorizing about self-affirmation (e.g., Cohen & Sherman, 2014; Sherman, 2013; Sherman & Hartson, 2011) and models of self-control. For instance, Inzlicht and Schmeichel (2012) propose that whether an individual deploys available resources is determined by their motivation and their attention to the necessity to do so, and Fujita, Trope, Liberman, and Levin-Sagi (2006) argue that a higher level of mental construal makes superordinate goals salient, with concomitant effects on resource deployment; self-affirmation has been shown to induce higher levels of construal (Schmeichel & Vohs, 2009; Waksal & Trope, 2009). Self-affirmation can also focus attention on important, self-relevant stimuli (Klein & Harris, 2009; Legault et al., 2012) and increase motivation (Harris, Mayle, Mabbott, & Napper, 2007) and task engagement (Creswell et al., 2013).

Naturally, the study has limitations that need to be borne in mind when interpreting the findings. As with the previous studies of the effects of self-affirmation on performance on executive function tasks (Legault et al., 2012; Logel & Cohen, 2012), the sample size was relatively small and only powered to detect medium-to-large effects. Consequently, although together these three studies provide convergent evidence that self-affirmation can boost performance on executive function tasks, replication with larger samples is desirable. Participants were also predominantly white, female, British students. The beneficial effects of self-affirmation across domains such as alcohol consumption or task performance have been observed in both community samples (e.g. Armitage, Harris, Hepton, & Napper, 2008; Logel & Cohen, 2012) and student samples (e.g. Epton & Harris, 2008), suggesting that the effects found here may not be peculiar to this sample; nevertheless, testing the effect of self-affirmation on executive functioning in larger and more diverse samples, and establishing whether changes in executive functioning mediate these beneficial outcomes, are important next steps for this research. Future research may also wish to explore whether the order of the tasks moderates the effects of self-affirmation on performance.

In sum, this study supports the notion that self-affirmation achieves its wide-ranging effects in part by influencing elements of executive functioning. The exact mechanism is unclear, but one plausible explanation is that self-affirmation facilitates better use of available executive functioning resources. Self-affirmation has been found to have beneficial effects on health-related behaviors, academic achievement and problem-solving tasks, all of which require high levels of executive functioning. Therefore, the finding that self-affirmation facilitates better use of executive functioning resources offers a plausible link between the various areas in which self-affirmation has been found to have beneficial effects.

Acknowledgements

We would like to thank Donna Jessop for her help and feedback. This research was funded by a studentship awarded to Philine Harris from the Economic and Social Research Council (grant number ES/J500173/1) and forms part of her doctoral dissertation. The funding body had no other involvement in this research. The findings have been presented at the conference of the European Health Psychology Society in 2015. The data supporting this study are available at: <http://reshare.ukdataservice.ac.uk/852543/>.

References

- Allan, J. L., Johnston, M., & Campbell, N. (2011). Missed by an inch or a mile? Predicting the size of intention-behaviour gap from measures of executive control. *Psychology & Health*, 26(6), 635–650. <http://dx.doi.org/10.1080/08870441003681307>.
- Armitage, C. J. (2016). A brief psychological intervention to protect subjective well-being in a community sample. *Quality of Life Research*, 25(2), 385–391. <http://dx.doi.org/10.1007/s11136-015-1076-6>.
- Armitage, C. J., Harris, P. R., Hepton, G., & Napper, L. (2008). Self-affirmation increases acceptance of health-risk information among UK adult smokers with low socioeconomic status. *Psychology of Addictive Behaviors*, 22(1), 88–95. <http://dx.doi.org/10.1037/0893-164X.22.1.88>.
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, 74(5), 1252–1265. <http://dx.doi.org/10.1037/0022-3514.74.5.1252>.
- Bouffard-Bouchard, T. (1990). Influence of self-efficacy on performance in a cognitive task. *The Journal of Social Psychology*, 130(3), 353–363. <http://dx.doi.org/10.1080/00224545.1990.9924591>.
- Chartrand, T. L., & Bargh, J. A. (1996). Automatic activation of impression formation and memorization goals: Nonconscious goal priming reproduces effects of explicit task instructions. *Journal of Personality and Social Psychology*, 71(3), 464–478. <http://dx.doi.org/10.1037/0022-3514.71.3.464>.
- Cohen, G. L., & Sherman, D. K. (2014). The psychology of change: Self-affirmation and social psychological intervention. *Annual Review of Psychology*, 65, 333–371. <http://dx.doi.org/10.1146/annurev-psych-010213-115137>.
- Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap. *Science*, 324(5925), 400–403. <http://dx.doi.org/10.1126/science.1170769>.
- Creswell, J. D., Dutcher, J. M., Klein, W. M., Harris, P. R., & Levine, J. M. (2013). Self-affirmation improves problem-solving under stress. *PLoS One*, 8(5), e62593. <http://dx.doi.org/10.1371/journal.pone.0062593>.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113–126. <http://dx.doi.org/10.1037/0022-3514.44.1.113>.
- Epton, T., & Harris, P. R. (2008). Self-affirmation promotes health behavior change. *Health Psychology*, 27(6), 746–752. <http://dx.doi.org/10.1037/0278-6133.27.6.746>.
- Epton, T., Harris, P. R., Kane, R., van Koningsbruggen, G. M., & Sheeran, P. (2014). The impact of self-affirmation on health-behavior change: A meta-analysis. *Health Psychology*, 34(3), 187–196. <http://dx.doi.org/10.1037/hea0000116>.
- Fujita, K., Trope, Y., Liberman, N., & Levin-Sagi, M. (2006). Construal levels and self-control. *Journal of Personality and Social Psychology*, 90(3), 351–367. <http://dx.doi.org/10.1037/0022-3514.90.3.351>.
- Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85(2), 197–216. <http://dx.doi.org/10.1037/0022-3514.85.2.197>.
- Griffin, R. J., Neuwirth, K., Giese, J., & Dunwoody, S. (1999). The relationship of risk information processing to consideration of behavioral beliefs. *Proceedings of the Annual Meeting of the Association for Education in Journalism and Mass Communication*. New Orleans, Louisiana: August (pp. 3–8).
- Hagger, M. S., Chatzisarantis, N. L. D., Alberts, H., Angonno, C. O., Batailler, C., Birt, A., ... Zwienerberg, M. (2016). A multi-lab pre-registered replication of the ego-depletion effect. *Perspectives on Psychological Science*, 2, 546–573. <http://dx.doi.org/10.1177/1745691616652873>.
- Harris, P. S., Harris, P. R., & Miles, E. (2016). Self-esteem moderates the effect of self-affirmation on positive affect. *Manuscript in preparation* (in preparation).
- Harris, P. R., Mayle, K., Mabbott, L., & Napper, L. (2007). Self-affirmation reduces smokers' defensiveness to graphic on-pack cigarette warning labels. *Health Psychology*, 26(4), 437–446. <http://dx.doi.org/10.1037/0278-6133.26.4.437>.
- Harris, P. R., Griffin, D. W., Napper, L., Schütz, B., Stride, C., & Bond, R. (2016). Individual differences in self-affirmation: distinguishing self-affirmation and positive self-regard. *Manuscript in preparation* (in preparation).
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16(3), 174–180. <http://dx.doi.org/10.1016/j.tics.2012.01.006>.
- Inzlicht, M., & Schmeichel, B. J. (2012). What is ego depletion? Toward a mechanistic revision of the resource model of self-control. *Perspectives on Psychological Science*, 7(5), 450–463. <http://dx.doi.org/10.1177/1745691612454134>.
- Jostmann, N. B., & Koole, S. L. (2007). On the regulation of cognitive control: Action orientation moderates the impact of high demands in Stroop interference tasks. *Journal of Experimental Psychology: General*, 136(4), 593–609. <http://dx.doi.org/10.1037/0096-3445.136.4.593>.
- Jurado, M. B., & Rosselli, M. (2007). The elusive nature of executive functions: A review of our current understanding. *Neuropsychology Review*, 17(3), 213–233. <http://dx.doi.org/10.1007/s11065-007-9040-z>.
- Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General*, 132(1), 47–70. <http://dx.doi.org/10.1037/0096-3445.132.1.47>.
- Klein, W. M., & Harris, P. R. (2009). Self-affirmation enhances attentional bias toward threatening components of a persuasive message. *Psychological Science*, 20(12), 1463–1467. <http://dx.doi.org/10.1111/j.1467-9280.2009.02467.x>.
- Kramer, A. F., & Erickson, K. I. (2007). Capitalizing on cortical plasticity: Influence of physical activity on cognition and brain function. *Trends in Cognitive Sciences*, 11(8), 342–348. <http://dx.doi.org/10.1016/j.tics.2007.06.009>.
- Legault, L., Al-Khindi, T., & Inzlicht, M. (2012). Preserving integrity in the face of performance threat: self-affirmation enhances neurophysiological responsiveness to errors. *Psychological Science*. <http://dx.doi.org/10.1177/0956797612448483>.
- Lezak, M. D. (1982). The problem of assessing executive functions. *International Journal of Psychology*, 17(1–4), 281–297. <http://dx.doi.org/10.1080/00207598208247445>.
- Logel, C., & Cohen, G. L. (2012). The role of the self in physical health testing the effect of a values-affirmation intervention on weight loss. *Psychological Science*, 23(1), 53–55. <http://dx.doi.org/10.1177/0956797611421936>.
- MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, 109(2), 163–203. <http://dx.doi.org/10.1037/0033-2909.109.2.163>.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100. <http://dx.doi.org/10.1006/cogp.1999.0734>.
- Miyake, A., Kost-Smith, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, 330(6008), 1234–1237. <http://dx.doi.org/10.1126/science.1195996>.
- Neff, K. D. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity*, 2(3), 223–250. <http://dx.doi.org/10.1080/15298860309027>.
- Nelson, S. K., Fuller, J. A., Choi, I., & Lyubomirsky, S. (2014). Beyond self-protection self-affirmation benefits hedonic and eudaimonic well-being. *Personality and Social Psychology Bulletin*, 40(8), 998–1011. <http://dx.doi.org/10.1177/0146167214533389>.
- Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin*, 126(2), 220–246. <http://dx.doi.org/10.1037/0033-2909.126.2.220>.
- Roberts, R. J., Jr., & Pennington, B. F. (1996). An interactive framework for examining prefrontal cognitive processes. *Developmental Neuropsychology*, 12(1), 105–126. <http://dx.doi.org/10.1080/87565649609540642>.

- Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.
- Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology*, 28(2), 573–594. http://dx.doi.org/10.1207/s15326942dn2802_2.
- Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A re-evaluation of the life orientation test. *Journal of Personality and Social Psychology*, 67(6), 1063–1078. <http://dx.doi.org/10.1037/0022-3514.67.6.1063>.
- Schmeichel, B. J., & Vohs, K. (2009). Self-affirmation and self-control: Affirming core values counteracts ego depletion. *Journal of Personality and Social Psychology*, 96(4), 770–782. <http://dx.doi.org/10.1037/a0014635>.
- Schwarzer, R., & Jerusalem, M. R. (1995). Generalized self-efficacy scale. In J. Weinman, S. Wright, & M. Johnson (Eds.), *Measures in health psychology: A user's portfolio. Casual and control beliefs* (pp. 35–37). Windsor, UK: NFER-NELSON.
- Sherman, D. K. (2013). Self-affirmation: Understanding the effects. *Social and Personality Psychology Compass*, 7(11), 834–845. <http://dx.doi.org/10.1111/spc3.12072>.
- Sherman, D. K., & Cohen, G. L. (2006). The psychology of self-defense: Self-affirmation theory. In M. P. Zanna (Ed.), *Advances in experimental social psychology*. Vol. 38. (pp. 183–242). San Diego, CA: Academic Press.
- Sherman, D. K., & Hartson, K. A. (2011). Reconciling self-protection with selfimprovement: Self-affirmation theory. In M. Alicke, & C. Sedikides (Eds.), *The handbook of self-enhancement and self-protection* (pp. 128–151). New York, NY: Guilford Press.
- Sherman, D. A., Nelson, L. D., & Steele, C. M. (2000). Do messages about health risks threaten the self? Increasing the acceptance of threatening health messages via self-affirmation. *Personality and Social Psychology Bulletin*, 26(9), 1046–1058. <http://dx.doi.org/10.1177/01461672002611003>.
- Sherman, D. K., Cohen, G. L., Nelson, L. D., Nussbaum, A. D., Bunyan, D. P., & Garcia, J. (2009). Affirmed yet unaware: Exploring the role of awareness in the process of self-affirmation. *Journal of Personality and Social Psychology*, 97(5), 745–764. <http://dx.doi.org/10.1037/a0015451>.
- St Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *The Quarterly Journal of Experimental Psychology*, 59(4), 745–759. <http://dx.doi.org/10.1080/17470210500162854>.
- Steele, C. M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. In L. Berkowitz (Ed.), *Advances in experimental social psychology*. Vol. 21. (pp. 261–302). New York: Academic Press.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643–662. <http://dx.doi.org/10.1037/0096-3445.121.1.15>.
- Suchy, Y. (2009). Executive functioning: Overview, assessment, and research issues for non-neuropsychologists. *Annals of Behavioral Medicine*, 37(2), 106–116. <http://dx.doi.org/10.1007/s12160-009-9097-4>.
- Sweeney, A. M., & Moyer, A. (2015). Self-affirmation and responses to health messages: A meta-analysis on intentions and behavior. *Health Psychology*, 34(2), 149–159. <http://dx.doi.org/10.1037/hea0000110>.
- Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades and interpersonal success. *Journal of Personality*, 72(2), 271–324. <http://dx.doi.org/10.1111/j.0022-3506.2004.00263>.
- Townsend, J. T., & Ashby, F. G. (1983). *Stochastic modeling of elementary psychological processes*. Cambridge, UK: Cambridge University Press.
- Usala, P. D., & Hertzog, C. (1989). Measurement of affective states in adults: Evaluation of an adjective rating scale instrument. *Research on Aging*, 11(4), 403–426. <http://dx.doi.org/10.1177/0164027589114001>.
- Wakslak, C., & Trope, Y. (2009). The effect of construal level on subjective probability estimates. *Psychological Science*, 20(1), 52–58. <http://dx.doi.org/10.1111/j.1467-9280.2008.02250.x>.